FINITE SIZE EFFECTS NEAR THE LIQUID-GAS CRITICAL POINT OF ^{3}He

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Abstract

A joint experimental and theoretical project has led to progress in understanding the effects of finite size near a simple liquid-gas critical point. Theoretical work includes the investigation of a new method to calculate the dimensional crossover in the case of a system with slab-like geometry. Predictions from this new method for the temperature dependence of the linear susceptibility and specific heat at constant volume will be presented for the case of the ^{3}He critical point. Experimentally, we have demonstrated that the electrostrictive technique is a viable method for measuring the linear susceptibility near the critical point. An experimental cell has been fabricated to measure the crossover of the susceptibility from 3-D to 2-D behavior in a 6 μm capacitor gap using the electrostrictive technique. In addition, parallel plate capacitors with gap sizes ranging from 0.5 to 5 μm are being prepared from silicon wafers that will enable further exploration of the finite size effect in the 2-D region. The results of a feasibility study for using an ac technique to measure the specific heat near a liquid-gas critical point will also be discussed. The salient features of the various finite size experimental cell designs for measuring the susceptibility and specific heat near the ^{3}He critical point will be presented.